Understanding and Solving the Beaver (*Castor fiber* L.)-Human-Conflict: An Opportunity to Improve the Environment and Economy of Poland

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Abstract

As a result of over-trapping and deforestation, beavers (*Castor fiber*) were nearly extinct in Poland by 1900. Following legal protection and reintroduction efforts they now number 18.000–23.000. With their resurgence, beavers are affecting changes that include higher groundwater levels, increased sedimentation in beaver impoundments, growing biodiversity of lentic communities, and diminished streambank erosion. By 2001 beavers created about 15.000 ha of wetlands and improved habitat for other animals and plants on roughly 21.000 ha. Increased beaver numbers have intensified beaver-human-conflicts. Management strategies that retain the benefits of beavers while minimizing related economic losses are outlined. Principles of successful beaver management are also detailed: (I) understanding population trends and limits, (II) enumerating the diverse ecological and hydrological values related to beavers, (III) protecting properties in a long-term, cost-effective manner that does not eliminate beavers, and (IV) educating the public. Survey results of beaver populations, beaver ecological effects, and human attitudes are presented. Management options that confront Poland and other European countries are discussed.

Key words: beaver, *Castor fiber*, influence on ecosystems, biodiversity

Zusammenfassung

Verständnis und Lösungsmöglichkeiten des Konfliktes zwischen Biber (*Castor fiber* L.) und Menschen: Eine Chance, die Umwelt und Wirtschaft Polens zu verbessern

Biber (*Castor fiber*) waren in Polen infolge von Überbejagung und Waldzerstörung um 1900 beinahe ausgerottet. Strenger Schutz bzw. Wiederansiedlungen führten zu einer Erholung der Bestände auf gegenwärtig 18.000–23.000 Tiere. Biber bewirken durch ihre Tätigkeiten eine Anhebung des Grundwasserpegels, vermindern die Ufer-Erosion und erhöhen die Biodiversität. So wurden im Jahr 2001 etwa 15.000 ha Feuchtgebiete durch Biber geschaffen und 21.000 ha anderer Habitate deutlich verbessert. Allerdings gab es durch das Anwachsen der Population auch vermehrt Mensch-Biber-Konflikte. Deshalb wird an Lösungsmöglichkeiten gearbeitet, die ökonomische Verluste minimieren, jedoch die positiven Effekte der Biberanwesenheit erhalten. Wir versuchen I) Entwicklungstrends und Grenzen der Ausbreitung zu erarbeiten, II) diverse ökologische bzw. hydrologische Benefits aufzuzeichnen, III) kostengünstige Methoden zum Schutz vor Biberschäden zu finden und IV) die Öffentlichkeit über Biber aufzuklären. Bestandskartierungsergebnisse, ökologische Effekte und Daten zur Haltung der Menschen gegenüber den Bibern werden präsentiert. Managementmöglichkeiten in Polen und Europa werden diskutiert.

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Introduction

Due to over-trapping and deforestation beaver population in Poland first started to decline in the Middle Ages. By the end of World War I beavers survived only in the Niemen and Prypeć tributaries in northeast Poland. In 1928 their population was estimated to be 235 animals; in 1939 it was about 400 animals (ZUROWSKI 1984; CZECH 1999). After World War II, due to illegal hunting during the war and shifting national borders, only a tiny beaver population survived in northern Poland. Reintroduction attempts initially failed because of small numbers and placement in coastal watersheds not connected to interior waterways. In 1974 when the total number of beavers was around 300, Professor Wirgiliusz ZUROWSKI of the Research Station of the Polish Academy of Sciences in Popielno initiated the Program for Active Protection of the European Beaver (ZUROWSKI 1984). The program reintroduced 4–6 pairs of beavers, each spaced 100 km along the Wisla river beginning from its mountain tributaries. Animals were taken from those bred at the Popielno beaver farm as well as ones used for hunting in the Suwalki area of Northeastern Poland (captured and moved in cooperation with the Polish Hunting Association). Simultaneously, existing populations began to join one another and expand. As a result, beavers occur all over the country today with the most numerous and dense populations in the northeast. The population is now about 23.000. Not surprisingly, beaver-human-conflicts have also been increasing. In 2002, regulations protecting beavers were relaxed; beaver dams can now be destroyed under certain conditions with permits from regional offices of government.

Beavers are a native species that, for thousands of years, was an important factor in shaping the environment, geomorphology, and culture of many areas of Europe and North America (JOHNSTON 1994). For example, the deep, fine-grained, nutrient-rich and streamside soil of abandoned beaver meadows often attracted farmers and other human colonists (OUTWATER 1996). Research on the influence of beavers on ecosystems has been done predominately by North American scientists (NAIMAN et al. 1986; NOVAK 1987; NAIMAN et al. 1988; SMITH et al. 1991; JOHNSTON & NAIMAN 1990; LISLE 1995; BUTLER, 1991; CIRMO & DRISCOLL 1993; CLIFFORD et al. 1993; HAMMERSON 1994; JOHNSTON 1994; BUTLER & MALANSON 1995). Beavers were described as a keystone species that creates habitats for other species. North American beavers (*Castor canadensis* K.) have modified 20–40 % of the total length of some low-gradient streams (JOHNSTON & NAIMAN 1990a), and beaver ponds can hold up to 40% of the water volume in 3rd and 4th order streams. (NAIMAN at al. 1988). Wetland ecosystems colonized by beavers are greatly different from those without beavers.

If detailed changes of the structure and dynamics of ecosystems by *C. canadensis* is well known, then surprisingly little attention has been paid to European beavers (NUMMI 1992; NOLET & ROSELL 1998). Perhaps this is because European researchers have been more focused on protection and reintroduction (PANFIL 1960; PUCEK 1972; ZUROWSKI & KASPERCZYK 1986; HARTMAN 1995; MICKUS 1995; BRZUSKI & KULCZYCKA 1999; CZECH 1999). Nevertheless, the hydrological and ecological effects and values of beavers in Europe have not gone unnoticed (BALODIS & DIMDIN 1980; GRACZYK 1978; TOPIŃSKI & BIERNACKA 1985; ZUROWSKI 1985; DERWICH 1995; HARTHUN 1996; CZECH 2000). Present knowledge about the scale and nature of beaver influence on ecosystems is still very vague; existing publications are more descriptive than statistically based. As a result, management decisions are often made subjectively. One example is the spending of taxpayer's money to compensate beaver damage while making no similar accounting of the wide-ranging values that beavers offer society. The purpose of this study is to try to help fill some of the gaps in this knowledge base.

More specifically, our goal was to:

- assess the influence of beavers on the ecosystems and economy of Poland;
- determine the number of beavers in Poland based on data from many sources;
- assess beaver population trends, especially in areas where density is high;
- determine the most common and expen-

sive damages done by beavers and the best methods to prevent them.

Methods

In 2000, based on government data, published papers and unpublished reports of Ministry of Environment, Regional Offices for Nature Conservation (RNC), we estimated beaver population distribution in Poland. In autumn 2000, 2001 and 2002 questionnaires were sent to all 440 forest districts, which cover the entire area of Poland. In addition, similar questionnaires were sent to 100 selected local communes and field units of the Polish Hunting Association.

The questionnaires included the following terms:

- location of beaver families
- number of beaver families
- estimated number of beavers
- trends in beaver population in last three years (increasing, decreasing, stable)
- percent of beaver colonies that caused damages

benefits because of beaver influence on:

- local hydrology and geomorphology (for example raising groundwater level, area of beaver-created wetlands, limiting erosion, etc.)
- area attractiveness for other animals, including game and plants
- area attractiveness for visitors
- limiting of danger of fire

losses caused by beavers, among others:

- flooding areas
- damage to embankments of rivers and fishponds
- blocking road culverts
- building canals on agricultural and forest areas
- cutting trees

interest in:

- beaver reintroduction
- beaver live-trapping to decrease number of nuisance beavers
- using devices which minimize damages from beaver activities

If there was no response, the sending of questionnaires was repeated and preceded by phone calls and fax correspondence. Forty sites mentioned in the questionnaires were tested in the field each year to check credibility of data and to conduct more detailed studies.

Simultaneously, in autumn 2000, 2001 and 2002 other questionnaires were sent to all 16 Regional Offices for Nature Protection, which also cover all of Poland. The questionnaires included the following categories:

- number of beaver families
- trends in beaver population in last three years (increasing, decreasing, stable)
- value of compensations paid in last three years
- percent of beaver colonies that caused damages

benefits because of beaver influence (to be ordered according to importance):

- local hydrology and geomorphology (for example raising groundwater level, area of beaver-created wetlands, limiting erosion, etc.)
- area attractiveness for other animals, including game and plant
- area attractiveness for visitors
- decreasing of danger of fire

losses caused by beavers (to be ordered according to importance):

- flooding of agricultural and forest areas
- damage to embankments of rivers and fishponds
- blocking road culverts
- building canals on agricultural and forest areas
- cutting trees

which beaver activity caused financial damages (to be ordered according to importance):

- flooding of agricultural and forest areas
- damage to embankments of rivers and fishponds
- blocking road culverts
- building canals on agricultural and forest areas
- cutting trees

interest in:

- beaver reintroduction
- beaver live-tapping to decrease number of nuisance beavers
- using devices which minimize damages from beaver activities

Parameter	Year 2001	Year 2002	Change
Number of colonies	4816	4981	+165 (3%)
Number of beavers	15411	17931	+2520 (14%)
Average number of beavers per colony	3,5	3,6	+0,1 (2,7%)

Tab. 1: Number of beaver colonies, total number of beavers, and average number of beavers in each colony in 2001 and 2002. A "colony" can be one individual or two or more, usually related, animals. The typical structure of a large colony would be a mated pair and their offspring from two previous years (rarely more than 10 individuals).

Results

Number, distribution and concentration of beavers between 2001 and 2002 (Tab. 1)

Results begin the year of the first standardized questionnaire (2001) because previous data is unreliable.

The increase in the total number of beavers, which was about 14 %, was not followed by a corresponding increase in the number of colonies. In areas where colony density was high an increase in average colony size was also observed in 5 % of districts. In 2002 beavers were found in 6 more districts than in 2001. However, they were still not present in 78 districts, mostly in western and southwestern Poland. The lowest concentration of beaver colonies (1–10 per district, 0,002–0,02 family/sq kilometer) was found in 260 districts (more than half), 24 more than in 2001. Medium concentrations (11–30 per district, 0,21–0,1 families /sq kilometer) were found in 75 districts, 18 districts less than in 2001. High concentrations (more than 30 families in district, more than 0,1 family /sq kilometer) were found only in 32 districts, an increase of 17.

Data from RNP indicates there were about 5576 colonies in 2002.

Beaver influence on ecosystems

Between 2001 and 2002 an increase of several parameters that characterize beaver influence on ecosystems was observed (Tab. 2).

Damage to human properties also increased (Tab. 3).

About 10 % of respondents from forest districts, local communes and units of the Polish Hunting Association were in favor of beaver reintroduction in their areas. Another 11 % were interested in live-trapping to decrease the number of nuisance beavers. And 62 % thought "flow devices", which protect property by controlling water levels without removing beavers, were a good idea.

RNC respondents indicated that beaver benefits included improving local hydrology and geomorphology (50 % of answers) as well as habitat value for other organisms, including game animals and plants (40 %). The most significant losses caused by beavers were flooding of agricultural and forest areas (55 %), damage to embankments of rivers and fishponds (50 %), and blocking road culverts (44 %). Most of the damages (87 %) had appeared in the same sites for more than 5 years.

About 5 % of RNC respondents were interested in beaver reintroduction in their areas. Another 9 % were interested in live-trapping to decrease the number of nuisance beavers. A further 72 % were interested in using flow devices. Around 3 % of beaver colonies caused damages. Most of the damages (80 %) appeared in the same sites for more than 5 years. Government compensa-

Parameter	Year 2001	Year 2002	Change
Area of beaver-created wetlands (ha)	15 000	17 000	+2 000 (12%)
Increase of attrac-tiveness for other animals and plants (ha)	21 000	23 000	+2 000 (9%)
Area attractiveness for visitors (ha)	12 000	15 000	+3 000 (20%)
Decreasing of danger of fire (ha)	5 000	10 000	+5 000 (50%)

Tab. 2: Change of certain parameters that characterize beaver influence on ecosystems.

Parameter	Year 2001	Year 2002	Change
Flooding of agricultural & forest areas (ha)	2 800	3 200	+ 400 (3%)
Damage to embank-ments of rivers and fishponds (km)	53	65	+12 (18%)
blocking road culverts (number)	161	229	+68 (29,6%)
Building canals on agricultural and forest areas (km)	7	15	+8 (53%)
Cutting trees (number)	15 000	20 000	+5 000 (25%)
Percent of beaver colonies that caused damages	4,3%	4,2%	- 0,1 (2%)

Tab. 3: Change of parameters that indicate damage to properties.

tion for damages was 160.000,– Euro in 2001 and close to 180.000,– Euro in 2002.

Discussion

The general goal of our study was to assess the ecological and cultural importance of beavers in Poland and to find compromises that benefit both landowners and ecosystems. It was important to sample public opinion and thereby benefit from the knowledge of many people who are responsible for land management and who have contact with beavers on a daily basis.

The number, distribution and concentration of beavers

Our study was the first one in Poland in 20 years to be allowed to determine the number of beavers based on multiple sources of data (Fig. 1). Our population estimate is half that previously given by the government (STATISTICAL YEARBOOK 2002). This discrepancy is probably due to earlier, unreliable methods of counting. For example, data was provided by people seeking compensation for damages – individuals who could benefit financially by over-estimates. Furthermore, they have no special training in beaver ecology.

The increase in the total number of beavers was not followed by a corresponding increase in the number of colonies. This could be explained by a "filling up" of territories, which may encourage young to stay at home longer than the two-year average. At the same time, a decrease in the mean number of newborn beavers was reported. This suggests that in addition to territorial behavior (ejecting beavers that are not members of the immediate family) beavers have internal mechanisms to control their population densities. In most of Poland increases in the density and number of beaver colonies was low, suggesting that food availability is also an effective population control mechanism in beavers.

The influence of beavers on ecosystems

Our research provides the first data on the broad scale influence of beavers in Poland. The area of beaver-created wetlands was around 17.000 hectares in 2002. Wetlands are arguably the rarest and most valuable wildlife habitats (Fig. 2). Our research shows a broad recognition of this by landowners and managers. The attractiveness of beaver habitats for other animals and plants has been reported by many authors (NUMMI 1992; NOLET & ROSELL 1998). The

Fig. 1: Wetland maintained by family of beavers for 15 years. (All figures from the authors.)

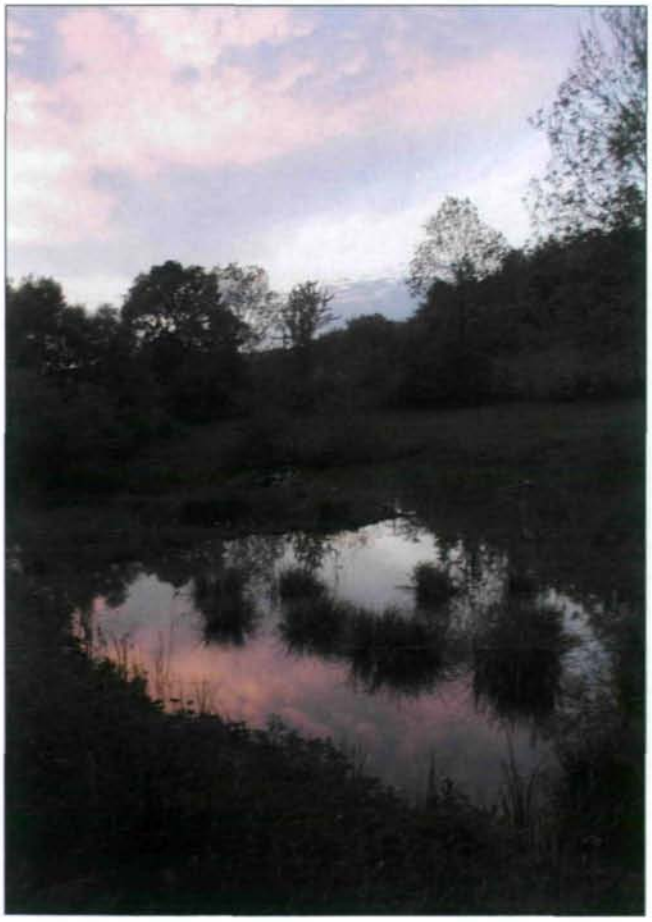

Fig. 2: Many beaver sites have high aesthetic values.

Fig. 3: In many situations tourists generate more money than beaver do damages.

ecological benefits of 1 ha of wetlands is estimated to be around 10.000,– Euro per year (CONSTANZA et al. 1989). To date 170.000.000,– Euro of ecological value has already been generated by beavers in Poland. In addition, wetlands are sponges and kidneys that store and purify water. Poland needs this service – it is among the countries in Europe with the poorest quality drinking water and surface water. Respondents also showed an interest in improving the potential for tourism in their areas. Beaver-created wetlands are fascinating habitats that have great potential in this regard. In Maine, USA, Japanese tourists have expressed interest in seeing beavers even before moose (*Alces alces*), which, by the way, are also often found in beaver-created wetlands (LISLE, pers. comm.)(Fig. 3).

Fig. 4: Beaver deceiver built in Vermont, USA.

The cost of beaver damages, most of which could be avoided with a serious program to install high-quality flow devices, pales in relation to the present and potential value of beavers.

Only a small percentage of beaver colonies caused problems (3–4,5 %). Moreover, many of the problem sites were repeat offenders: good habitats that kept attracting beavers, but where a permanent, non-lethal solution was not applied. This reflects data from the US that suggests that the beaver problem is manageable in scale despite population levels (LISLE 2001). This is because beavers, bound to water and specific habitats, only occupy a tiny percentage of the landscape. If the chronic problem sites in these areas are eliminated, the conflict will be largely ended too.

Beaver management: solving the beaver-human conflict

Attitudes towards beavers often exacerbate conflicts. Human perceptions of history and how the land is "supposed to be" frequently do not include the presence of beavers. Throughout most of history beavers had a significant influence on European ecosystems. Through cutting trees and dam building they modified the morphology and hydrology of streams and rivers. But when beavers were destroyed the wetland ecosystems that they maintained for millennia disappeared from the landscape for hundreds if not thousands of years. Consequently, we have forgotten how natural, native aquatic ecosystems are supposed to look. Beavers are symbolic of the loss of contact between modern humans and nature. Legal protection at the beginning of the 20th century saved the species, but beaver numbers today are only a small fraction of their previous grandeur. Beavers are still treated as a curiosity. And when conflicts arise, we often have little patience with this apparent invader – largely unknown to our experience or to that of our parent's – that wishes to change a tiny percentage of the landscape from a relatively sterile condition back into

the vibrant ecosystems that they used to be. A little tolerance, combined with taking responsibility for implementing creative, long-term solutions to protect properties would go a long way toward solving the beaver-human-conflict. Conversely, a combative attitude that sees "population management" as the only true solution will guarantee an endlessly annoying, frustrating, and expensive relationship with beavers (Fig. 4).

Beavers are a fact of life. In North America and in a growing segment of Europe they are either back, or are coming back. Would it be physically possible to eliminate them as we did before? Certainly. But it is unlikely that it would ever be politically possible. And who would want to sacrifice the values that they embody? So given that scenario, the best thing we can do is to outsmart them. The most important tool in that endeavor is an effective, high-quality flow device. Beavers represent a rare opportunity to allow a native, keystone species to revitalize long-degraded aquatic ecosystems at no cost. It is one we should seize.

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